CAAP Quarterly Report

Date of Report: *July 10, 2015*

Contract Number: *DTPH56-14-H-CAP01*

Prepared for: *DOT*

Project Title: *Patch and Full-Encirclement Repairs for Through-Wall Defects*

Prepared by: *The University of Tulsa*

Contact Information: *Michael W. Keller, mwkeller@utulsa.edu, 918-631-3198*

For quarterly period ending: *July 10, 2015*

Business and Activity Section

(a) Generated Commitments

There has been no change in project participants or other contracts.

Supplies Purchased	Cost
Grit Blasting	$444.33
Welding	$2400.00
Test Setup Supplies	$1034.50

(b) Status Update of Past Quarter Activities

In the past quarter (starting April 11, 2015), we have completed the following research activities

1. Continued finite element studies of repair.
2. Supported install of repairs on small-scale specimens.
3. Largely completed the test instrumentation and control system for the fatigue testing of small-scale specimens.

Small Scale Test Program

As of this progress report, two of the four participating companies have installed repairs on the through-wall defect specimens. These pipes are currently in storage as we wait for the remaining companies to install. We expect that this will happen during the next quarter (Beginning July 11). The test system is nearing completion and will begin shakedown testing in this quarter. The fatigue testing of the small scale pipe samples should begin in the next quarter.

FEA Studies of Through-wall Defects

During this quarter, we continued our FEA studies of the patch and full encirclement repairs. We have completed a couple of studies. The primary focus was the investigation of the length of the repair on the strain in the repair. There are several competing opinions regarding the calculations of the length of the repairs as presented in the ASME PCC2 standard the relevant ISO standard. We performed several simulations where we varied the length of the repair and investigated the in-plane shear strain at the

interface of the composite and the substrate.

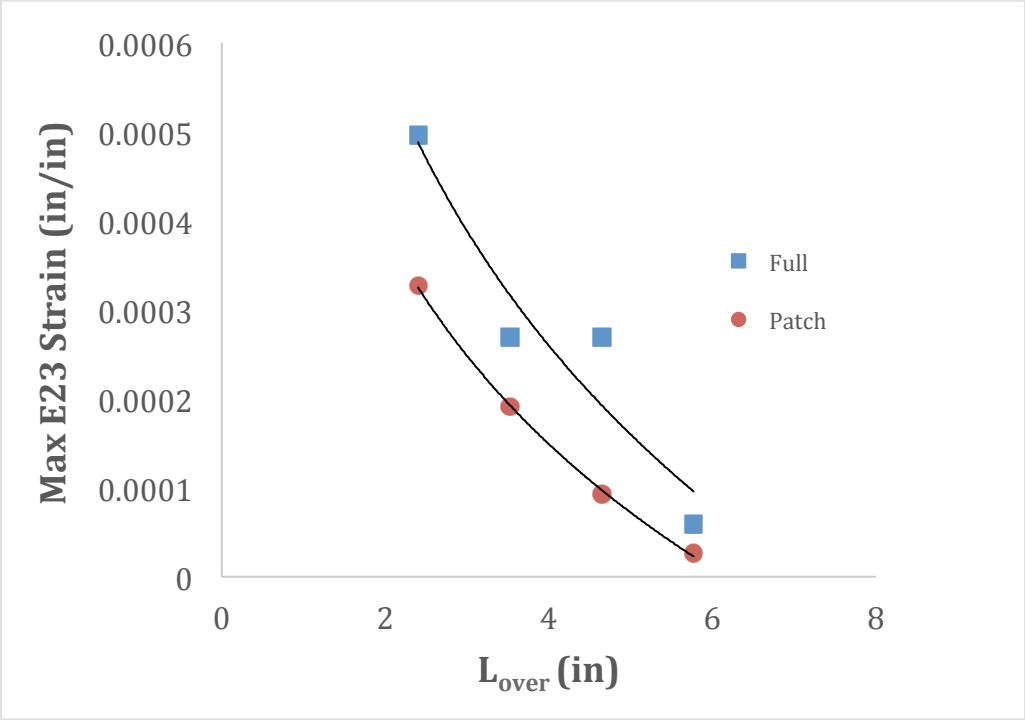

Figure 1: Comparison of interfacial shear strain as a function of extent of repair along the axis of the pressure vessel.

As seen in previous FEA studies the strain in the patch specimen is actually slightly lower than that of the full-encirclement repairs. In general increasing length of repair reduced the maximum interfacial shear stains rather significantly. This result does tend to lend support to the strain-based calculation of extent of repair as provided in PCC2 and ISO. We are working to understand exactly how critical this length is in ensuring a safe, reliable repair. It is important to note that, even at the shortest lengths, the shear strain values are very low with respect to the maximum failure strain of most composites (0.01 in/in).

We have also begun modeling the large scale vessel for comparison with future experimental results and to understand the differences between the two size scales. These simulations are just beginning and we do not yet have results. We expect these by the end of next quarter.

(c) Description of any Problems/Challenges

During this past quarter there were no significant challenges. We are working to make sure that the two patches related programs are moving together and are attempting to limit any slow-downs with respect to testing conflicts for these two test programs.

***(d)* Planned Activities for the Next Quarter** –
Planned activities for the next quarter include the following

1. Continue assembly and shakedown of pressure fatigue testing system.
2. Continued support installs of repairs on small-scale specimens
3. Initiation of the small scale specimen fatigue testing.
4. Continue FEA modeling of the repair.